Do All Cans Of Soda Have the Same Density?

By

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Period 8
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Statement of Purpose

The purpose of this project is to determine if all cans of soda have the same density in room temperature water.
HYPOTHESIS

If canned sodas are placed in an aquarium filled with water, then all the sodas will sink, because they all have a density greater than water.
Abstract

DO ALL CANS OF SODA HAVE THE SAME DENSITY?

McGinnis, Jill, E.

The purpose of this project is to determine if all sodas have the same density as water. If canned sodas are placed in an aquarium filled with water, then all the sodas will sink, because they all have a density greater than water.

Density is a measure of how much material is contained in a given volume of a substance. It is calculated by dividing the mass (in grams) of an object by the volume (in cm$^3$ or mL). By determining the density of an object one can identify the substance. No two pure substances will have the same density.

Water has a mass of 1g/cm$^3$ and is used a baseline density for many science experiments. Often substances are referred to as having a density greater than or less than water. It is known that substances denser than water will sink and those lighter than water will float. Ice, which is merely the solid form of water, has a density of .93 g/cm$^3$. This explains why ice floats in water. Salt water has a density that is greater than fresh water, therefore icebergs, which are mainly fresh water, float on or near the surface of the ocean.

All of the diet sodas floated when placed in room temperature tap water. All of the regular sodas sank to the bottom of the aquarium filled with room temperature water. There was one exception, the Dr. Pepper floated. An additional experiment would need to be conducted to determine why this happened.

The purpose of this project is to determine if all sodas have the same density as water. If canned sodas are placed in an aquarium filled with water, then all the sodas will sink, because they all have a density greater than water. All of the diet sodas floated when placed in room temperature tap water. All of the regular sodas sank to the bottom of the aquarium filled with room temperature water. There was one exception, the Dr. Pepper floated. An additional experiment would need to be conducted to determine why this can floated. Based on this data the hypothesis was not supported.
Density is a measure of how much material is contained in a given volume of a substance. It is calculated by dividing the mass (in grams) of an object by the volume (in cm$^3$ or mL). By determining the density of an object one can identify the substance. No two pure substances will have the same density. This would be useful, for example, in determining the value of a sample of a metal, to determine if it is gold or iron.

Water has a mass of 1g/cm$^3$ and is used a baseline density for many science experiments. Often substances are referred to as having a density greater than or less than water. We know that substances that are denser than water will sink and those lighter than water will float. Ice, which is merely the solid form of water, has a density of .93 g/cm$^3$. This explains why ice floats in water. Salt water has a density that is greater than fresh water, therefore icebergs, which are mainly fresh water, float on or near the surface of the ocean. This also explains why there are hot spots or cold spots in the coastal waters. Compared to water, gold has a density of 19.3g/cm$^3$. Atmospheric air, which many mistakenly believe does not have mass, in fact has a mass of .0013 g/cm$^3$. Other gases, such as helium are even light than this explaining why a helium filled balloon will float.

The density of liquids are measured in g/mL. The mL is equal to 1 cm$^3$. When calculating the density of a liquid, the unit of volume is the mL. Water in the liquid state would actually have a density of 1g/mL and in the solid state (ice) the density would be written as .93g/cm$^3$. As soon as one begins to understand how interchangeable these units are, one can begin to compare the densities of many different substances and predict their behaviors in specific situations.

The ingredients in a typical can of soda are listed on each package. This makes comparing them relatively easy. Sweetener is one of the ingredients in a regular soda. This sweetener may be pure cane sugar or high fructose corn syrup. When either of these is added to water it will
increase the density of the water. The sweetener adds mass to the water therefore it increases the density. As mass increases so does density. Conversely, as mass decreases so does density.

Artificial sweeteners, such as saccharin, do not add significant mass to a can of soda. There is also CO$_2$ gas added to canned soda to give them their effervescence quality. It is true that CO$_2$ is less dense than water, so why is it that the can of soda will sink in water? The combined total of all the ingredients will become a density that is specific to that substance. Through experimentation we can determine if all soda will sink, or only the ones that contain sugar/high fructose corn syrup.
VARIABLES

**Independent Variable**
Cans of soda

**Dependent Variable**
Density of the soda

**Constants/Controls**
Amount of water inside the aquarium
Temperature of the soda in the cans
Size of the aquarium
Size (volume and mass) of the soda cans
Temperature of the water in the aquarium
List of materials and Equipment

- One 5 gallon aquarium
- An assortment of 6-10 varieties of 12 ounce sodas in aluminum cans at room temperature. Be sure to include some diet sodas and some regular sodas
- A source of tap water
Procedures

1. Gather a collection of soda varieties (6-10). Keep them at room temperature.

2. Fill a 5 gallon aquarium with tap water.

3. Place each can into the aquarium to see if it floats or sinks.

4. Record results for each soda in a data table. (observations)

5. Compare sodas based on diet vs. regular.

6. Record any trends that you see.
DATA TABLE

- All the diet sodas floated.
- All but one of the regular sodas floated.
- The one outlier was a regular Dr. Pepper.

<table>
<thead>
<tr>
<th>Soda Name</th>
<th>floats</th>
<th>sinks</th>
<th>Sugar (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROOT BEER</td>
<td>X</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>THROWBACK PEPSI</td>
<td>X</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>REGULAR COKE</td>
<td>X</td>
<td></td>
<td>39</td>
</tr>
<tr>
<td>DIET COKE</td>
<td>X</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>DIET PEPSI</td>
<td>X</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>COKE ZERO</td>
<td>X</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>REGULAR PEPSI</td>
<td>X</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>GRAPETTE</td>
<td>X</td>
<td></td>
<td>49</td>
</tr>
<tr>
<td>DR. PEPPER</td>
<td>x</td>
<td></td>
<td>40</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

AVERAGE OF NON DIET SODAS = 43 g
Analysis of Data

All of the diet sodas floated when placed in room temperature tap water. All of the regular sodas sank to the bottom of the aquarium filled with room temperature water. There was one exception, the Dr. Pepper floated. I would need to conduct an additional experiment to determine why this can floated. Based on this data I can determine that diet sodas have a density less than tap water. I can further recognize that regular soda almost always is denser than water.
Conclusion

The purpose of this project is to determine if all canned sodas have the same density as water. If canned sodas are placed in an aquarium filled with water, then all the sodas will sink, because they all have a density greater than water. All of the diet sodas floated when placed in room temperature tap water. All of the regular sodas sank to the bottom of the aquarium filled with room temperature water. There was one exception, the Dr. Pepper floated. I would need to conduct an additional experiment to determine why this can floated. Based on this data, my hypothesis was not supported.
Bibliography
Acknowledgments
Appendix